

CEYLON J. SCI.(BIO. SCI.) VOL. 19&20, 1986-87

AN ECOLOGICAL STUDY OF THE MANGROVE FAUNA IN THE WEST COAST OF SRI LANKA

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ABSTRACT

There is a general paucity of mangrove macrofauna in numbers as well as in diversity in the west coast of Sri Lanka. The macrofauna is dominated by the cerithidean gastropods and grapsid crabs. 8 Species of polychaetes, 17 species of molluscs (10 bivalve and 7 gastropod), 22 species of decapods (including 8 species of crabs), 3 species of holothuroids, 75 species of fish, 7 species of frogs and toads, 14 species of reptiles, 50 species of birds, and 15 species of mammals were recorded in mangroves, their associated mudflats, and adjacent estuarine waters, during the present study. The mangrove fauna can broadly be divided into two categories, that which depends on the mangrove for its successful existence (true or obligatory mangrove fauna), and that which makes use of the presence of mangroves but could occur elsewhere successfully (facultative mangrove fauna). The latter group may further be divided into three types, that which spends its entire life in the mangrove (resident fauna), that which spend only a part of its life cycle in the mangrove (transitory fauna), and that which move into the mangrove temporarily for food and feeding etc. (adventitious or incidental fauna). A clear-cut zonation of individual animal species was not seen, probably because the mangroves are very limited in extent and width. However, different zones within the mangrove are occupied by different groups of species. The degraded nature of the Sri Lankan mangroves and the presence of crop plantations and human settlements adjoining mangroves also have significantly influenced the faunistic composition of the mangroves. The examination of the mangrove food web indicates that the energy is exported mainly through vertebrates and the portunid crab Scylla serrata.

INTRODUCTION

Mangrove formations (or mangals, as some authors prefer to call them reserving the term mangrove for individual tree species) in Sri Lanka are found scattered mainly along the sheltered shores of the estuaries in the west and east coasts. Although very limited in extent in some instances, they are found in most of the estuaries, sometimes only in the distal shores, a few kilometres inland, of caecum-like estuaries. The extent of

mangroves in the entire island has been estimated as little over 6,000 ha recently (Jaywardene, 1985), although the total area of brackishwater estuaries, mudflats and marshes is about 122,000 ha. Most of the mangroves in Sri Lanka have been subjected to human interference for a long time, and as a result undisturbed mangroves are hard to find.

Although Sri Lankan mangroves have not been studied as extensively and as intensively as those of some countries of South East Asia, the major species of macroflora and most of the macrofauna are known from various works of a taxonomic nature (Trimen, 1893-1900; Pillai, 1960, 1961, 1965, 1970; Arulchelvam, 1968; de Bruin, 1970; Fernando, 1977; Costa, 1979; de Silva & Silva, 1979; de Silva, 1983). The interest in fauna appears to be focused on that of the estuaries rather than that of the mangrove proper. However, some ecological aspects of oysters (Perera & Arudpragasam, 1966; Pinto & Wignarajah, 1980) and crabs (Pinto, 1984) in mangroves have been studied. But, little is known of the life cycles of most of the species. Studies on ecology, zonation and pattern of distribution as well as biology of mangrove species in Sri Lanka are lacking, except for those mentioned earlier. Hermit crabs, insects and insect larvae, spiders, and vertebrates (except fish) have not been studied at all. Development and recruitment of even the economically important species such as the fishes, shrimps, crabs and oysters are not known.

The present study deals mainly with the macro-invertebrate fauna and vertebrate fauna, their distribution and zonation, and the food web in the mangroves on the west coast of Sri Lanka.

MATERIALS AND METHODS

Several mangroves were examined along the west coast both in the dry zone (annual rainfall in the coastal area 900 to 1,800 mm) and in the wet zone (annual rainfall in the coastal area 1,900 to 2,500 mm) (Fig. 1). Mangroves in the river estuaries of the Ginganga, Kala Oya and Pomparippu Ara, and those on the shores of larger islands in Kalpitiya, Negombo and Balapitiya estuaries, as well as those on the mainland bordering these estuaries and the Hikkaduwa estuary (Fig. 1), were studied during 1985/86. Samples of macrofauna such as crabs, gastropods, bivalves, hermit crabs, shrimps and prawns, holothurians, and fish, were collected from the mangroves, their associated mudflats, and adjacent estuarine waters. Samples of soil (sediment) were obtained within mangroves, from mudflats at low tide, and from the beds of sea grasses. They were filtered through a strainer with a mesh size of 1 mm² in order to collect the infauna. Zooplankton were collected from Kalpitiya, Negombo and Balapitiya estuaries by drawing a zooplankton net (mesh size 335 µm) through water from a slow-running boat. Samples of fish

were obtained by using a cast net as well as from the catch of the fishermen. Amphibians, reptiles, birds and mammals within the mangroves and in the vicinity were noted. Specimens of frogs and toads, and some species of lizards, snakes, bats, rats and shrews were collected, but it was not possible to collect specimens of some species of reptiles and mammals. Birds were identified using the descriptions given by Henry (1971) and Phillips (1978), but specimens were not collected.

RESULTS

Mangroves on the west coast were not extensive and were often restricted to narrow strips along the shores of estuaries and islands within estuaries. The coastal brackishwater bodies of Sri Lanka come under the category of estuaries (rather than lagoons), according to Pritchard's (1967) generally accepted definition (de Silva & Balasubramaniam, 1987). Therefore, those at Balapitiya, Hikkaduwa, Kalpitiya and Negombo are considered as estuaries in the present study, although they are popularly called lagoons.

On the whole there was a paucity of mangrove fauna, both in numbers and in diversity, in comparison with that found in some countries of South East Asia. Within mangroves the commonest epifauna was cerithidean gastropods and grapsid crabs. Cerithidea spp. were observed in all mangroves. C. quadrata was observed among Rhizophora and other trees, but always in the shade. It was abundant in the Kalpitiya area. C. cingulata was common in all mangroves and observed in more open places, especially among the roots of Avicennia. It was also seen on the mudflats. The habitats of the two species are thus different, although they are found in the same zone (Fig.2). A temperature difference as high as 5°C was noted between the open and shaded places when the tide was in. They become active and start to move about with the incoming tide.

Grapsid crabs were common in all mangroves and included Chiromantes spp., Neosermatium spp. and Neoepisesarma versicolor. When the mangrove was flooded the crabs were often seen on the lower branches of the trees above the water level. Ocypodid crabs were not as common as the grapsid crabs in the Kalpitiya mangroves, but included Macrophthalmus spp. and the fiddler crabs, Uca spp. However, Uca spp. were quite common in the mudflats of Negombo mangrove. The portunid crab Scylla serrata was ubiquitous, being in all estuaries examined. It was especially common in the Kalpitiya estuary, where it was caught in commercially important numbers for export. A few specimens of thalamita crenata and Neptunus pelagicus were also collected from the beds of sea grasses adjoining the Kalpitiya mangrove. A zonation of various crab species, especially within the same genus, was difficult to discern because the mangroves were not extensive. But, Uca spp. were common in the mudflats in the fore-mangrove. Macrophthalmus spp. were found in the mangrove proper. Grapsid crabs were also found in the mangrove proper,

but usually smaller species were found closer to the lower edge of the mangrove and the larger species closer to the upper edge (Fig. 2). The land crab, Cardisoma sp. was found in the back mangrove and in the adjoining scrub zone. Scylla serrata, Thalamita crenata and Neptunus pelagicus were found in the estuary adjoining the mangrove. They sometimes ventured into the mangrove proper at high tide.

The anomuran mud lobster Thalassina anomala was seen in its mud mounds at Kalpitiya and Negombo estuaries, and these mud mounds were also observed in Hikkaduwa mangrove. Hermit crabs Eupagurus sp. and Pagurus sp. were observed in all mangroves. The hermit crabs were seen on mudflats and near the lower edge of the mangrove, while T. anomala was observed at the upper edge of the mangrove and sometimes in the back mangrove (Fig. 2).

Several species of penaeid prawns were seen in the estuaries adjoining mangroves. The common species were Penaeus indicus, P. semisulcatus, Metapenaeus dobsoni and M. elegans. P. semisulcatus was common in the Kalpitiya area (dry zone) but was rare in the Balapitiya area (wet zone). Macrobrachium spp. (Family Palaemonidae) were also seen in the adjoining estuaries. M. rosenbergi was the commonest, but M. equidens was also frequent. Caridina spp. (Family Atyidae) were found in the wet zone estuaries but not in the Kalpitiya estuary. These species were collected from the mud and debris at the lower edge of the mangrove. Isopods and amphipods were seen in rotting tree trunks and sometimes also under the fallen leaves.

The bivalves Anadara spp., Geloina spp., and Gaffrarium tumidum, were common in the mud in the shallow estuaries, and were also found among sea grasses and occasionally within mangroves. The oysters Crassostrea spp. and the barnacle Balanus amphitrite were seen attached to the submerged stems and prop roots of Rhizophora spp. and in the shallow region of estuaries. Perna spp., Marcia spp., Pinna bicolor and the gastropod Pleuroploca trapezium were found in the estuary adjoining the mangroves in Kalpitiya. The gastropod Faunus ater was collected from Balapitiya, Hikkaduwa and Negombo estuaries but not from the Kalpitiya estuary. Littorina scabra and Nerita polita were found attached to the stems, roots and branches of mangrove trees.

Serpulid polychaetes Neodexiospira fauveli, Neopomatus similis, and Neopomatus uschakovi were found attached to oyster shells, prop roots of Rhizophora and leaf petioles of Nypa. The nereid Perinereis nuntia, the orbinid Scoloplos sp., and the glycerids Glycera rousii, Eunice savignyi and Diopatra sp. were found in the mud. Scyphozoan jelly fishes were frequently observed in Kalpitiya and Negombo estuaries and on one occasion in Hikkaduwa estuary.

Larvae of prawns and crabs, copepods, and nauplii, were common in the zooplankton of all estuaries examined. However, some differences in the zooplankton composition in wet zone and dry zone estuaries were noted. For instance, Caprella sp. and Noctiluca sp. were common in the Kalpitiya estuary, but were not collected from the other three estuaries. Zooplankton of Negombo estuary was dominated by Ceratium sp. while that of Hikkaduwa and Balapitiya estuaries were dominated by nauplii and copepods. Cladocerans and rotifers were also observed in the latter two estuaries but not in the Kalpitiya estuary.

A list of invertebrate macrofauna recorded from the mangroves and adjacent estuaries by the present authors and others is given in Appendix 1.

The common fish species in the estuaries included mugilids, cichlids, carangids, gobiids and siganids. The cichlid Eetroplus suratensis was common in Negombo, Balapitiya and Hikkaduwa estuaries; the exotic Oreochromis mossambicus was also common. Periophthalmus koelreuteri was seen in the mudflats and on the prop roots of Rhizophora, both in the wet zone and the dry zone. Fish fry and fingerlings and juvenile prawns were often seen in small, more or less permanent water holes and small channels of water within mangroves.

Toads (Bufo melanostictus) and tree frogs (Kaloula pulchra, Microhyla rubra and Rhacophorus leucomystax) were collected among mangrove associates in the back mangrove. Frogs (Rana spp.) were collected from pools of water within the mangroves at Hikkaduwa and Balapitiya. The water snake Cerberus rhynchops was collected among the prop roots of rhizophora in Kalpitiya and Negombo estuaries. Gerardia prevostiana was collected inside the Kala Oya mangrove. Natrix piscator was frequent in both Balapitiya and Hikkaduwa estuaries among Rhizophora roots. Land snakes Ptyas mucosus and Vipera russelli were occasionally seen in Balapitiya and Hikkaduwa mangrove, among mangrove associates. A specimen of Python molurus was caught by the villagers in the back mangrove of one of the islands in Balapitiya estuary during the period of study. The lizards Calotes versicolor, Mabuya macularia, and Varanus bengalensis were also seen in the back mangroves of Hikkaduwa and Balapitiya estuaries. The water monitor Varanus monitor was observed in the mudflats and within mangroves of all estuaries. The geckos Hemidactylus frenatus and Lophopolis scabriceps were occasionally seen on the trees in the back mangroves of Hikkaduwa and Balapitiya. The crocodiles Crocodylus palustris and C. porosus were caught by the villagers in Balapitiya and Hikkaduwa estuaries respectively, and eye witnesses stated that they rest on mudflats and that a nest with eggs was once found within the mangrove in one of the islands in Balapitiya estuary. The terrapin Melanochelys trijuga was observed in water at the edge of Kala Oya mangrove.

Several species of birds, both indigenous and winter migrants, are observed in the mangroves and their associated mudflats and shores. These included kingfishers on the branches of the mangrove trees, sandpipers, cormorants, plovers, egrets and lapwings on the mudflats, birds of prey soaring above the mangroves, as well as barbets, sunbirds, parrot etc. in the back mangrove. A list of birds observed is given in Appendix 2.

Tracks of two carnivora were seen within Kala Oya mangrove. These were identified as those of the jackal, Canis aureus, and the jungle cat Felis chaus, both of which were observed by others within the mangrove. There was evidence that these two carnivores feed on mangrove crabs. Rats (Rattus rattus), bandicoot rats (Bandicota bandicota) and shrews (Suncus murinus) were seen in the back mangrove at Balapitiya estuary. The mongoose Herpestes fuscus was observed in Negombo, Balapitiya and Hikkaduwa back mangroves. Civet cats and palm cats (probably Viverricula indica and Paradoxurus hermaphroditus) were observed in the back mangrove trees at Balapitiya. A family of wild pigs, Sus scrofa was once seen in the back mangrove at Balapitiya estuary. Donkeys, Equus asinus, frequent in Kalpitiya area, were occasionally seen wandering on to the mudflats at low tide. Dugongs, Dugong dugon, infrequently entered the Kalpitiya estuary and were known to feed on the sea grasses in the fore-mangrove. The large fruit bat, Pteropus giganteus, was seen to visit mangroves at Balapitiya and Hikkaduwa in the evening and feed on the fruits of Sonneratia caseolaris. Specimens of the macrochiropteran Cynoptera sp. (probably C. sphinx), and the microchiropterans Myotis hasselti and Rhinopus sp. were collected in the mangrove area of Balapitiya estuary.

A list of vertebrate fauna recorded in mangroves and adjacent estuaries in Sri Lanka is given in Appendix 2. A generalized food web of the west coast mangroves constructed by examining gut contents of various species and on other evidence is given in Fig. 3.

DISCUSSION

Mangroves are a unique ecosystem consisting of a complex assemblage of salt-tolerant plant which are adapted to a life in the intertidal zone. They provide a wide variety of habitats for various animal species. Some of these animal species are adapted to a life in the mangroves, whereas others take advantage of the presence of mangroves for obtaining food, shelter etc. The former group include the true mangrove fauna, which should be able to tolerate the rather harsh ecological conditions present in the mangroves. For instance, the soil (or sediment) in the mangroves is often a rich mud and develops anaerobic conditions. It is covered twice daily by salt water (at high tides). During the drought, hypersaline conditions may develop, and during

rains salinity may become quite low. Thus, the benthic fauna of the mangroves has not only to withstand desiccation and a wide range of salinity, as the intertidal shore fauna does, but also to cope with anaerobic conditions. However, because of the high organic content in the sediment and the high primary productivity of the mangroves, many animals, especially macrobenthos, are found there. For instance, in Towra point, New South Wales, Australia, it has been estimated that 1 m² contains upto 100 animals of 35 different species (West, 1985).

Since the mangroves develop in the intertidal zone, most of their animals are either intertidal estuarine animals or species that are derived from them. Since mangroves are also transitional between the terrestrial and marine habitats on the one hand, and freshwater and marine habitats on the other, some of the marine, terrestrial and freshwater animals are also found in them. Mangrove fauna may be divided into two categories, namely, (i) that which lives successfully only within the mangrove (true or obligatory mangrove fauna) and (ii) that which makes use of the availability of mangroves for some biological activities such as feeding, breeding etc. (facultative mangrove fauna). The second category could be subdivided into three types, namely, (i) fauna that lives its entire life in the mangrove (resident fauna), (ii) that which spends only one or more stages of its respective life cycles or only part of its life in the mangrove (transitory fauna), and (iii) that which makes use of the mangrove temporarily for feeding, shelter, breeding etc. (adventitious or incidental fauna). Some of the epifauna such as grapsid crabs, Thalassina anomala, Cerithidea quadrata etc. can be considered as the true mangrove fauna. Other epifauna and infauna such as tubicolous polychaetes, ocypodid crabs, hermit crabs, sedentary animals such as oysters and barnacles, can be considered as the resident mangrove fauna. Penaeid prawns and fish species, the juveniles of which develop in the mangroves or in the adjacent estuaries but entering mangroves for food and shelter (e.g. Chanos chanos), can be considered as the transitory mangrove fauna. Other fish species which live in the estuaries but enter the mangroves at high tide, herpetofauna, birds and mammals, are all opportunists and can be considered as the adventitious mangrove fauna. However, it is difficult to place some species rigidly in one category or another. Most species that are listed by many authors as mangrove fauna in fact come under the category of facultative mangrove fauna according to this scheme.

Mangrove substratum provides suitable habitats for polychaetes, molluscs and decapods. The latter two groups dominate mangrove macrofauna in many countries. Sri Lankan mangrove macrofauna is no exception to this. In Malaysia, 27 species of molluscs, 48 species of crustaceans and three species of polychaetes have been recorded from mangroves (Sasekumar, 1974). In Thailand, 55 species of molluscs, 50 species of crustaceans (including 47 species of decapods) and 27 species of polychaetes have been recorded (Shokita, 1985). In Sri Lanka,

40 species of molluscs, 45 species of crustaceans (including 40 species of decapods) and 34 species of polychaetes have been recorded (Appendix 1).

Many fish species have been recorded from mangrove areas of various countries. For instance, 77 species have been recorded from Pichavaram, S.E. India (Krishnamurthy & Jayaseelan, 1981), 102 species from Ramong province in Thailand (Bhovichitra et al., 1982), over 150 species from Philippines (J.A. Ordenez, personal communication), 81 species from Fiji (Lal, Swamy & Singh, 1983), and 204 species from New Guinea (Collette, 1983). 78 species of fish were recorded in estuarine waters adjoining the mangroves during the present study, whereas 158 species have been recorded in estuarine waters in Sri Lanka (Appendix 2). Since almost all the estuaries from which these species have been recorded have at least a small area of mangrove, it is very possible that most, if not all, would enter the mangroves during some stage of their life cycle. Thus, they may be considered as facultative mangrove fauna. Information available on other vertebrates in mangrove areas is very scanty. Six species of frogs and toads, four species of terrapins, six species of lizards, 18 species of snakes and four species of crocodiles have been recorded in the mangrove areas of Thailand (Nabhitabhata, 1985), in comparison with seven species of frogs and toads, one species of terrapin, six species of lizards, six species of snakes, and two species of crocodiles recorded by the present authors in the mangrove areas on the west coast of Sri Lanka (Appendix 2). 106 Species of birds (indigenous and migrant) and 24 species of mammals have been recorded in the mangrove areas of Thailand (Sittilert, 1985), in comparison with 69 species of birds and 15 species of mammals recorded during the present study. However, a more detailed census would probably reveal many more species of birds and mammals in the mangrove areas of Sri Lanka. For instance, 152 species of birds have been recorded from the shores of estuaries in Sri Lanka (Appendix 2). It is not clear whether these estuaries (Henry, 1971; Phillips, 1978) had associated mangroves, but since many estuaries in Sri Lanka contain at least a small area of mangrove, most of these species, if not all, must be visiting mangrove areas at one time or another. Sittilert's (1985) list of mammals of Thai mangroves include a tree shrew, a flying lemur, seven species of bats, a slow loris, a crab eating macaque, three species of squirrels, three species of rats, an otter, three species of civet cats, the leopard cat, the wild pig and the lesser mouse deer, and since these or species of similar habits are present in forest areas adjoining the mangroves of Sri Lanka (e.g. Wilpattu National Park adjoining the Kala Oya mangrove), a wider variety of mammals, than what was recorded in the present study, could be expected to visit mangrove areas.

Some differences in the floristic composition in the mangroves of wet zone and dry zone have been noted (de Silva & Balasubramaniam, 1987). However, no clear-cut differences were noted in the faunistic composition in the mangroves of the two zones, except for some differences in the zooplankton (some freshwater species were noted in the wet zone estuaries and some marine species in the dry zone estuaries), molluscs (Faunus ater occurred in the wet zone estuaries and some bivalve species such as Anadara spp. occurred in the dry zone estuaries), and birds (some species were confined to the dry zone and others to the wet zone). These differences are probably due to salinity and climatic differences in the two zones. However, these species are facultative mangrove fauna and the differences are unlikely to be due to due to floristic and other differences in the mangroves, and would remain even in the absence of the mangroves. The highest number of species was recorded in the Kalpitiya mangrove, the second highest in the Negombo mangrove and the lowest in the Hikkaduwa mangrove. These differences in the macrofauna are probably due to the size differences of the respective estuaries and mangroves, Kalpitiya estuary and mangrove being the largest, and Hikkaduwa estuary and mangrove being the smallest, among those that were studied.

Apart from the usual factors such as tidal amplitude, salinity, geomorphic and sedimentation characteristics that affect the floristic and faunistic compositions of the mangroves, three other factors have significantly affected the faunistic composition of Sri Lankan mangroves. (1) Sri Lankan mangroves are highly interfered with. Many areas of mangroves are cleared completely and the larger trees are selectively felled in the other areas for various purposes. Mangrove associates and even non-mangrove trees are present in the mangrove proper of some areas. This would obviously have affected the mangrove fauna that existed in these areas. (2) In some areas, crop plantations and human settlements have been established next to mangroves, often in localities cleared of the mangrove that existed (e.g. Hikkaduwa, Balapitiya and Negombo mangrove areas). Some mangroves such as that in Negombo estuary are being used as rubbish dumps and public lavatories. Fertilizers and pesticides washing out from the plantations, oil from fishing boats, biological pollution due to the presence of human settlements, would also have affected the mangrove fauna significantly. Moreover, the establishment of crop plantations, fisheries, and human settlements would have brought along with it fauna of these habitats. For instance, several vertebrate species that usually live in association with houses and home gardens (e.g. geckos, house sparrows, and scavengers such as crows and rats) may have been introduced into mangrove areas. Other vertebrate species that would have been normally present in the mangroves (e.g. terrapins, wading birds, otters and dugongs) may have been kept away by man. (3) Tropical Sri Lanka, because of its position at the tip of Indian sub-continent, forms the favourite wintering quarters of many species of migrant birds. Most of these may make at least a temporary stop-over at the shores of estuaries and mangroves.

The "typical" faunistic composition would probably be observed only in the Kala Oya mangrove, which is the least disturbed in the west coast and which forms, a part of the southern boundary of the Wilpattu National Park, the latter having a rich variety of relatively undisturbed terrestrial and freshwater flora and fauna.

The food web of the mangrove (Fig. 3) indicates that the energy is exported from the mangrove mainly through the vertebrates. Among invertebrate macrofauna, the most important in this respect is Scylla serrata, which is a top carnivore. Most of the food chains start with detritus, which is the most important contribution of the mangroves to the estuarine ecosystem. Mangroves contribute in three ways to increase the productivity of the estuaries. (1) The nutrients and minerals brought in by land drainage are trapped within the mangroves. But for mangroves these nutrients etc. would have dispersed very quickly making them less available to other flora and fauna. (2) the mangrove flora entraps light energy through photosynthesis and makes it available to the food web. Species other than mangrove flora are unlikely to colonize successfully these rather inhospitable mudflats. (3) Mangroves provide food, and shelter from predators, to juveniles of many finfish and shellfish species. Thus, the removal of mangroves will significantly reduce the productivity of the estuaries, as has been observed in the Hikkaduwa mangrove. The mangrove cover has been removed very much in recent times in this estuary and, according to fisherman, the production of finfish and shellfish has dwindled tremendously in recent years.

ACKNOWLEDGEMENTS

We wish to thank Professors M.D. Dassanayake and S. Balasubramaniam of Department of Botany for their advice and help during the course of this work, and Professor H. Crusz of Department of Zoology for critically reading the manuscript. Thanks are also due to Mr. T.S.B. Alagoda for drawing the figures. We are indebted to Mr. N.M. Moiyadeen, O.I.C., NARA Regional Research Station, Kalpitiya, for helping us in many ways during the study of Kalpitiya mangroves. The help given by Dr. J.M.R.S. Bandara, Head, Department of Agricultural Biology, and Professor K. Jayasena, Department of Pharmacology, in providing vehicles to visit various sites is gratefully acknowledged. This work was supported by the research grant No. RGB/ Gen /50 of Natural Resources, Energy and Science Authority of Sri Lanka.

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Appendix 1

Macro invertebrate fauna recorded from the mangroves and adjoining estuaries in Sri Lanka. The presence of a particular species in a particular locality is indicated either by a "*" (recorded by the present authors) or by a "X" (recorded by others). The following localities are considered: B-Balapitiya estuary; C-Batticaloa estuary; H-Hikkaduwa estuary; K-Kalpitiya estuary; N-Negombo estuary; T-Trincomalee estuary. Sources: Data of the present authors and of others cited in the List of References.

SPECIES	K	N	B	H	C	T
POLYCHAETA						
<u>Ammotrypane grandis</u> Pillai						X
<u>Axiothella tambalaqamensis</u> Pillai						X
<u>Diopatra neapolitana</u> Chiaje						X
<u>Diopatra</u> sp.	*					
<u>Eunice savignyi</u> Grube			*			X
<u>Glycera rouxi</u> Audouin & M. Edwards						X
<u>Heteromastides platyproctus</u> Pillai						X
<u>Heteromastus deductus</u> Pillai						X
<u>Hydroides inornata</u> Pillai		X				
<u>H. norvegica</u> Gunnerus		*X				
<u>H. tambalaqamensis</u> Pillai						X
<u>Laonice brevicristata</u> Pillai						X
<u>Loimia decora</u> Pillai						X
<u>Lumbrinereis emandibulata</u> Pillai						X
<u>L. pseudopolydesma</u> Pillai						X
<u>Marphysa borradalei</u> Pillai					X	X
<u>M. sanguinea</u> (Montagu)						X
<u>Neanthes manatensis</u> Day		X				
<u>Neodexiospira fauveli</u> Pillai	*X	*				
<u>N. tambalaqamensis</u> Pillai		*X				
<u>Neopomatus similis</u> Pillai		*X				
<u>N. uschakovi</u> Pillai	*	*X	*X		X	
<u>Nereis</u> sp.					X	
<u>Notomastus ceylonicus</u> Pillai						X
<u>Perinereis nuntia</u> (Sav.)	*					X
<u>Polydora armata</u>					X	
<u>Polydora</u> sp.		X				
<u>Pomatoleicos crosslandi</u> (Pixell)						X
<u>Potamilla brevitrochica</u> Pillai						X
<u>P. leptochaeta</u> (Southern)					X	X
<u>Scoloplos gracilis</u> Pillai						X
<u>S. marsupialis</u> Southern						X
<u>Tambalaqamia fauveli</u> Pillai						X
<u>Trypanosyllis zebra</u> Grube		X				
POLYPLACOPHORA						
<u>Squamopleura imitator</u> (Nierstrasz)		X				

SPECIES	K	N	B	H	C	T
CEPHALOPODA						
<u>Sepia</u> sp.	*					
BIVALVIA						
<u>Anadara antiquata</u> (L.)	*X					
<u>A. clathrate</u> (Reeve)						
<u>Barbatia obliquata</u> (Gray)						
<u>Brachydontes variabilis</u> Krauss			X			
<u>Crassostrea belcheri</u> (Sowerby)						
<u>C. cuculata</u> (Born)						
<u>C. madrasensis</u> (Preston)						
<u>Donax cuneata</u> (L.)						
<u>D. faba</u> (Gmelin)						
<u>Dosinia cretacea</u> (Reeve)						
<u>Gafrarium divaricata</u> (Chemnitz)						
<u>G. tumidum</u> (Roding)	*					
<u>Gari variegata</u> (Wood)						
<u>Gelonia coaxans</u> (Gmelin)	*					
<u>G. ceylonica</u> (Gmelin)	*					
<u>Larkinia rhombea</u> (Born)						
<u>Mactra lurida</u> (Phillippi)						
<u>Marcia hiantina</u> (Lamarck)						
<u>M. opima</u> (Gmelin)	*					
<u>Martesia striata</u> L.		X				
<u>Meretrix casta</u> (Gmelin)	*	*	*	*		
<u>M. meretrix</u> (L.)			*	*		
<u>Modiolus auriculatus</u> (Krauss)						
<u>Perna perna</u> (L.)	*	*				
<u>P. viridis</u> (L.)						
<u>Pinna bicolor</u> (Gmelin)	*					
<u>Placuna placenta</u> (L.)						
<u>Spondylus descalis</u> Roding		X				
<u>Teredo</u> sp.	*	*X				
GASTROPODA						
<u>Cassidula mustelina</u> (Angas)	*					
<u>Cellana radiata</u> (Born)		X				
<u>Cerithidea cingulata</u> (Gmelin)	*	*	*	*		
<u>C. quadrata</u> (L.)	*	*	*	*		
<u>Eucheus asper</u> (Gmelin)		X				
<u>Faunus ater</u> (L.)		*	*	*		
<u>Littorina scabra</u> L.	*	*X				
<u>Nerita polita</u> (L.)	*	*X				
<u>Pleuroploca trapezium</u> (L.)	*					
<u>Telescopium telescopium</u> (L.)						
AMPHIPODA						
<u>Ceradocus</u> sp.		X				
<u>Lembos</u> sp.		X				

SPECIES	K	N	B	H	C	T
ISOPODA						
<u>Cirolana willeyi</u> Stebbing		X				
<u>Ligia exotica</u> Roux		X				
CIRRIPEDIA						
<u>Balanus amphitrite</u> Darwin	*X	*	*			
DECAPODA-CARIDEA						
<u>Alpheus edwardsi</u> (Andonunin)		*X				
<u>Caridina gracilirostris</u> De Man			*	*		
<u>C. propinqua</u> De Man			*	*		
<u>C. typus</u> M. Edwards			*	*		
<u>C. zeylanica</u> (Arud. & Costa)			*	*		
<u>Macrobrachium australe</u> (Guerin)				*		
<u>M. equidens</u> (Dana)		*X				
<u>M. idae</u> (Heller)						X
<u>M. latidactylus</u> (Thallwitz)						X
<u>M. rosenbergi</u> (De Man)		*X	*	*	*	
<u>M. scabriculum</u> (Heller)						X
<u>M. srilankense</u> Costa		X				
DECAPODA - PENAEIDEA						
<u>Metapenaeus burkenroadi</u> Kubo	X	X				
<u>M. dobsoni</u> (Miers)		*X	*X	*X		
<u>M. elegans</u> De Man		*X	*X	*X		
<u>Parapenaeopsis cornuta</u> (Kishinouye)			X			
<u>Penaeus indicus</u> M. Edwards	*X					
<u>P. latisulcatus</u> Kishinouye	X	*X				
<u>P. monodon</u> Fabricius			*X	*X	*	
<u>P. semisulcatus</u> De Haan	*X	*X				
DECAPODA - ANOMURA						
<u>Eupagurus</u> sp.	*	*	*	*		
<u>Pagurus</u> sp.	*	*	*	*		
<u>Thalassinia anomala</u>	*	*X				
DECAPODA - BRACHYURA						
<u>Cardiosma</u> sp.	*		*	*		
<u>Chiromantes bidens</u> (De Haan)	*	*X	*	*		
<u>C. darwinensis</u> Campbell		X				
<u>C. indiarum</u> (De Haan)	*	*X	*	*		
<u>Macrophthalmus depressus</u> Ruppell	*	*X	*	*		
<u>M. parvimanus</u>		X				
<u>M. sulcatus</u> (M. Edwards)		X				
<u>Metopograpsus messor</u> (Forsk.)		X				
<u>Neopisesarma versicolor</u> (Tweedie)	*	*X	*	*		
<u>Neosermatium indicum</u> (Henderson)		X				
<u>N. smithi</u> (M. Edwards)		X				
<u>Neptunus pelagicus</u> (L.)	*	*X				

SPECIES	K	N	B	H	C	T
<u>Thalamita prenata</u> (M. Edwards)		X				
<u>Scylla serrata</u> (Forsk.)	*	*X	*	*		
<u>Uca lactea</u> (De Haan)	*	*X				
<u>U. dussumieri</u> (M. Edwards)		X				
<u>Uca</u> sp.		*				
<u>Varuna socialis</u> Stebbing		X				

Appendix 2

Vertebrate fauna recorded by the present authors and others in and around mangroves in Sri Lanka. The localities of the species recorded by the present authors shown by symbols within square brackets. B-mangroves in Balapitiya estuary; H-mangroves in Hikkaduwa estuary; K-mangroves in Kalpitiya estuary; N-mangroves in Negombo estuary. Sources: Data of present authors, and of others cited in the list of References.

PISCES

ELASMOBRANCHII - TRYGONIDAE

Amphotistius imbricatus (Bloch & Schneider) [K]
Himantura bleekeri (Blyth) [K]

TELEOSTEI

ACANTHURIDAE

Acanthurus gahm (Forsk.) [K,N]
Ctenochaetus strigosus (Bennett) [K,N]

ALBULIDAE

Albula vulpes (L.)

AMBASSIDAE

Ambassis commersoni Cuvier [K,N]
A. gymnocephalus (Lacepede) [K,N]
A. urotaenia Bleeker [K,N]

ANGUILLIDAE

Anguilla bicolor McClelland [K]
A. nebulosa McClelland

ATHERINIDAE

Allanetta forskali (Ruppell) [K,N]
Pranesus duodecimalis (Valenciennes)

BAGRIDAE

Macrones gulio (Hamilton-Buchanan)

BELONIDAE

Tylosurus strongylurus (Van Hasselt) [B,H,K,N]

BOTHIDAE

Pseudorhombus arsius (Ham.-Buch.) [H]
P. triocellatus (Bloch) [B,H]

CARANGIDAE

Alectis ciliaris (Bloch)
Carangoides gymnostethoides Bleeker
C. malabaricus (Bloch) [B,H,N]

Caranx ignobilis (Forsk.) [K,N]
C. sanson (Forsk.) [H,K]
Chorinemus lysan (Forsk.)
C. tala Cuvier [K]
Decapterus russelli (Ruppell)
Gnathanodon spicatus (Forsk.) [K]
Megalaspis cordyla (L.)
Trachinotus blochi (Lacepede)
T. russelli Cuvier

CHANIDAE

Chanos chanos (Forsk.) [K]

CICHLIDAE

Etroplus maculatus (Bloch) [N]
E. suratensis (Bloch) [B,H,K,N]
Oreochromis mossambicus (Peters) [B,H,K,N]

CLUPEIDAE

Harengula ovalis (Bennett) [B,H,N]
Kowala coval (Cuvier) [K,N]
Macrura kelee (Cuvier)
Opisthopterus tardoore (Cuvier)
Pellona ditchela Valenciennes

CYNOGLOSSIDAE

Cynoglossus lingua Ham.-Buch.
C. macrolepidotus (Bleeker)

CYPRINODONTIDAE

Aplocheilichthys blochi (Arnold)
A. melastigma (McDermid) [B,H,N]
A. panchax (Hamilton) [B,H]

DOROSOMIDAE

Nematolosa nasus (Bloch) [K]

DUSSUMIERIDAE

Ehirava fluviatilis Deraniyagala [N]

ELEOTRIDAE

Butis butis (Ham.-Buch.)
Eleotris fusca (Schneider) [N]
Eleotriodes muralis (Valenciennes)
E. sexguttatus (Valenciennes)
Ophiocara porocephala (Valenciennes)

ELOPIDAE

Elops machnata (Forsk.)

ENGRAULIDAE

Thrissina baelama (Forsk.)

GERRIDAE

Gerreomorpha setifer (Ham.-Buch.) [K]
Pertica filamentosa (Cuvier)

GOBIIDAE

Acentrogobius griseus (Day) [K]
Callogobius hasseltii (Bleeker)
Glossogobius giuris (Ham.-Buch.) [H,N]
Mugilogobius valigouva (Deraniyagala)
Stigmatogobius sadanundio (Ham.-Buch.)

HEMIRHAMPHIDAE

Hemirhamphus marginatus (Forsk.) [H,K]
Hyporhamphus gaimardi (Valenciennes) [H]
Zenarchopterus dispar (Valenciennes) [H]

KUHLIDAE

Kuhlia marginatus (Cuvier) [H]
K. taenurus (Cuvier)

LABRIDAE

Thalassoma umbristigma (Ruppel)

LAGOCEPHALIDAE

Amblyrhynchotes hypselogenion (Bleeker) [N]

LATIDAE

Lates calcarifer (Bloch) [K,N]
Psammoperca waiensis (Cuvier)

LEIOGNATHIDAE

Leiognathus daura (Cuvier) [K]
L. equulus (Forsk.) [H,K,N]
L. fasciatus (Lacepede) [H,K,N]
L. splendens (Cuvier) [H,K,N]

LOBOTIDAE

Lobotes surinamensis (Bloch)

LUTIANIDAE

Lutianus argentimaculatus (Forsk.) [K,N]
L. johni (Bloch)
L. kasmira (Forsk.) [H,N]
L. russelli (Bleeker)

MEGALOPIDAE

Megalops cyprinoides (Broussonet)

MENIDAE

Mene maculata (Bloch)

MONODACTYLIDAE

Monodactylus argenteus (L.) [K]

MUGILIDAE

Liza cascasia (Ham. -Buch.)
L. dussumieri (Valenciennes) [B,H,K,N]
L. kelaartii Gunther [H,K,N]
L. macrolepis (Smith)
L. oligolepis (Bleeker) [H,K,N]
L. parsia (Ham.-Buch)
L. strongylocephalus (Richardson)
L. tade (Forsk.) [B,H,K,N]
L. walgiensis (Quoy & Gaimard)
Mugil borneensis Bleeker
M. cephalus L.
Valamugil buchani (Bleeker) [H,N,K]

MULLIDAE

Upeneus vittatus (Forsk.)

MURAENOSOCIDAE

Muraenesox cinereus (Forsk.)

MURAENIDAE

Gymnothorax polyuranodon (Bleeker) [K]
Pseudechidna brummeri (Bleeker)
Thyrsoidea macrura (Bleeker) [K]

OPHICHTHYIDAE

Caecula orientalis (McClelland) [H]
C. polyphthalmus (Bleeker)
Callichelys longipinnis (Kner & Steindachner)
Ophichthys rhytidodermatoides (Bleeker) [H]
Pisodonophis cancrivorus (Richardson)

PERIOPHTHALMIDAE

Periophthalmus koelreuteri (Pallas) [B,H,K,N]
P. sobrinus Eggert
P. vulgaris Eggert

PLECTORYNCHIDAE

Gaterin schotaf (Forsk.)

PLOTOSIDAE

Plotosus canius Ham.-Buch. [K,N]

POLYNEMIDAE

Eleutheronema tetradactylum (Shaw)

Polynemus heptadactylus Cuvier

P. indicus Shaw

P. plebeius Broussonet

SCATOPHAGIDAE

Scatophagus argus (L.) [K,N]

SCIAENIDAE

Johnius diacanthus (Lacepede)

SERRANIDAE

Epinephelus fario (Thunberg)

E. fasciatus (Forsk.) [H,N]

E. malabaricus (Schneider) [H]

E. merra Bloch

E. tauvina (Forsk.) [K,N]

SIGANIDAE

Siganus javus (L.) [K,N]

S. oramin (Bloch & Schneider) [K]

S. stellatus (Forsk.) [K,N]

S. vermiculatus (Valenciennes)

SILLAGINIDAE

Sillago maculata Quoy & Gaimard

S. sihama (Forsk.) [H]

SOLEIDAE

Brachirus orientalis (Bloch)

SPARIDAE

Acanthopagrus berda (Forsk.)

SPHYRAENIDAE

Sphyraena jello Cuvier [K,N]

S. obtusata Cuvier

SYMBRANCHIDAE

Symbranchus bengalensis (McClelland)

SYNGNATHIDAE

Dorichthys cunculus (Ham.-Buch) [B,H]
D. ocellatus Duncker [B,H]
Ichthyocampus carce (Ham.-Buch.)
Microphis brachyurus (Bleeker)
Syngnathus spicifer (Bleeker)

TACHYSURIDAE

Aroides dussumieri (Valenciennes)
Batrachocephalus mino (Ham.-Buch.) [K]
Hexanematichthys sona (Ham.-Buch.)
Netuma thalassinus (Ruppell)
Osteogeneiosus militaris (L.)
O. stenocephalus Day
Pseudarius jaius (Ham.-Buch.) [K]
P. jella (Day)
P. platystomus (Day)
Tachysurus caelatus (Valenciennes)
T. maculatus (Thunberg) [K]
T. subrostratus (Valenciennes)
T. venosus (Valenciennes)

TETRAODONTIDAE

Chelonodon fluviatilis (Ham.-Buch.) [B,H,K,N]
C. patoca (Ham.-Buch.) [B,H,K,N]
Monotretus cutcutia (Ham.-Buch.) [K]

THERAPONIDAE

Autisthes puta (Cuvier) [H,K,N]
Eutheraon theraps (Cuvier)
Pelates quadrilineatus (Bloch)
Therapon jarbua (Forsk.) [B,H,K,N]

TOXOTIDAE

Toxotes chatareus (Ham.-Buch.) [K]

TRIACANTHIDAE

Triacanthus brevirostris Schlegel [B,H,K,N]
T. biaculeatus [B,H,K,N]

TRICHIURIDAE

Trichiurus haumela (Forsk.)
T. savaia Cuvier [K,N]

URANOSCOPIDAE

Ichthyoscopus lebeck (Bloch)

AMPHIBIA

BUFONIDAE

Bufo melanostictus Schneider [H]

MICROHYLIDAE

Kaloula pulchra taprobanica Parker [H]
Microhyla rubra (Jerdon) [H]

RANIDAE

Rana cyanophlyctis Schneider [B]
R. hexadactyla Lesson [B]
R. tigrina Jerdon [B]

RHACOPHORIDAE

Rhacophorus leucomystax (Gray) [K]

REPTILIA

EMYDIDAE

Melanochelys trijuga (Gray) [K]

CROCODYLIDAE

Crocodylus palustris Lesson [H]
C. porosus Schneider [B]

GEKKONIDAE

Calotes versicolor (Daudin) [B,H]
Hemidactylus frenatus Schlegel [H]
Lophopholis scabriceps (Annandale) [K]
Mabuia macularia (Blyth) [K]
Varanus cepedianus (Daudin) [K,B]
V. monitor (L.) [B,H,K,N]

BODIDAE

Python molurus (L.) [B]

COLUBRIDAE

Cerberus rhynchops Schneider [K]
Gerardia prevostiana (Eyedoux & Grevais) [K,N]
Natrix piscator (Schneider) [B,H]
Ptyas mucosus (L.) [B,H]

VIPERIDAE

Vipera russelli (Shaw) [B]

AVES

ACCIPITRIDAE

Haliaeetus leucogaster (Gmelin) [K]
Haliastur indus indus (Boddaert) [K]
Ichthyophaga ichthyaetus plumbeiceps Baker [K]

Milvus migrans govinda Sykes
Pandion haliaetus haliaetus (L.)
Spilornis cheela spilogaster (Blyth) [K]
Spizaetus cirrhatus cirrhatus (Gmelin) [K]

ALCEDINIDAE

Alcedo atthis taprobana Kleinschmidt
Ceryle rudis leucomelanura Reichenbach
Halcyon pileata (Boddaert)
H. smyrnensis fusca (Boddaert) [B,H,K,N]
Pelargopsis capensis capensis (L.) [K]

ANATIDAE

Anas acuta L.
A. clypeata L.
A. crecca crecca L.
A. penelope L.
A. querquedula L. [K]
Dendrocygna javanica (Horsfield)
Tadorna ferruginea (Pallas)

APODIDAE

Hemiprocne longipennis coronata (Tickell) [H]

ARDEIDAE

- Ardea cinerea rectirostris Gould
- A. purpurea manillensis Meyen
- Butorides striatus javanicus (Horsfield)
- Dupetor flavicollis flavicollis (Latham)
- Egretta alba modesta (Gray) [K]
- E. garzetta garzetta (L.) [K,N]
- E. gularis schistacea (Hemprich & Ehrenberg) [K]
- Nycticorax nycticorax nycticorax (L.)

BUCEROTIDAE

Anthracoceros coronatus coronatus (Boddaert)

BURHINIDAE

Burhinus oedicnemus indicus (Salvadori)
Esacus magnirostris recurvirostris (Cuvier)

CAPITONIDAE

Megalaima rubricapilla rubricapilla (Gmelin) [B]
M. zeylanica zeylanica (Gmelin) [B]

CHARADRIIDAE

Calidris ferruginea (Pontopoidan)
C. minutus (Leisler) [K]
C. temminckii (Leisler)

Charadrius alexandrinus alexandrinus L.
C. dubius jerdoni (Legge)
C. leschenaultii leschenaultii Lesson
C. mongolus atrifrons Wagler
Limicola falcinellus falcinellus (Pontopoidan)
Limosa lapponica lapponica (L.)
L. limosa limosa (L.)
Numenius arquata orientalis Brehm
N. phaeopus variegatus (Scopoli) [K,N]
Philomachus pugnax (L.)
Pluvialis squatarola (L.)
Tringa glareola L.
T. hypoleucos hypoleucos (L.) [H]
T. nebularia (Gunnerus)
T. stagnatilis (Bechstein) [K]
T. terek (Latham)
T. totanus eurhinus (Oberholster)
Vanellus indicus tankae (Koelz) [B,H, K,N]
V. malabaricus (Boddaert) [K]

CICONIIDAE

Anastomus oscitans (Boddaert)
Ibis leucocephalus (Pennant)

COLUMBIDAE

Chalcophaps indica robinsoni Baker
Streptopelia chinensis ceylonensis (Reinchenbach)
Treron bicincta leggei Hartert

CORACIIDAE

Coracias bengalensis indica L. [K]

CORVIDAE

Corvus macrorhynchos culminatus Sykes [B,K,N]
C. splendens protegatus Madarasz [B,H,K,N]

CUCULIDAE

Centropus sinensis parroti Stresemann [B]
Eudynamys scolopacea scolopacea (L.) [N]

DICRURIDAE

Dicrurus adsimilis minor Blyth
D. caerulescens insularis (Sharpe) [B,N]

DROMADIDAE

Dromas ardeola Paykull

HIRUNDINIDAE

Hirundo rustica rustica L. [H]

JACANIDAE

Hydrophasianus chirurgus (Scopoli)

LARIDAE

Childonias hybrida indica (Stephens)
C. leucoptera (Lemminck) [K,N]
Gelochelidon nilotica nilotica (Gmelin)
Hydroprogne capsia capsia (Pallas)
Larus brunnicephalus Jerdon
Sterna albifrons albifrons Pallas
S. bengalensis bengalensis Lesson
S. bergii velox Cretzschmar
S. hirundo tibetana Saunders

MEROPIDAE

Merops leschenaulti leschnaulti Vieillot [K]

MUSCICAPIDAE

Acrocephalus stentoreus brunescens (Jerdon)
Cisticola juncidis omalura Blyth
Copsychus saularis ceylonensis Sclater [B]
Orthotomus sutorius sutorius Pennant [B]
Terpsiphone paradisi ceylonensis (Zarudny & Harms) [B]
Turdoides affinis taprobanus Ripley [B,H,N]

NECTARINIIDAE

Nectarinia lotenia lotenia (L.) [B]

ORIOIDAE

Oriolus xanthornus ceylonensis Bonaparte [B]

PHELIPPIDAE

Pelicanus philippensis philippensis Gmelin

PHALACROCORACIDAE

Aphinga rufa melanogaster Pennant [K]
Phalacrocorax fuscicollis Stephens
P. niger (Vieillot) [N]

PHOENICOPTERIDAE

Phoenicopterus roseus Pallas

PICIDAE

Chrysocolaptes lucidus stricklandi (Layard) [K]
Dinopium bengalense psarodes (Leichenstein) [B]

PLOCEIDAE

Lonchura punctulata punctulata (L.) [B]

Passer domesticus indicus Jardine & Selby [B,H,N]
Ploceus manyar flaviceps Lesson

PSITTACIDAE

Psittacula cyanocephala cyanocephala (L.) [B]
P. eupatria eupatria (L.) [K]
P. krameri manillensis (Bechstein) [N]

PYCNONOTIDAE

Pycnonotus cafer haemorrhousus (Gmelin) [B,H]

RALLIDAE

Amaurornis phoenicurus phoenicurus (Pennant) [N]
Gallinula chloropus indica Blyth [N]
Rallus striatus albiventer Swainson

RECURVIROSTRIDAE

Himantopus himantopus ceylonensis Whistler
Recurvirostra avosetta L.

STRIGIDAE

Bubo zeylonensis zeylonensis (Gmelin) [B]

STURNIDAE

Acridotheres tristis melanosternus Legge [B,H,N]
Gracula religiosa indica (Cuvier) [B]

THRESKIORNITHIDAE

Platalea leucorodia major Temminck & Schlegel
Threskiornis melanocephala (Latham)

MAMMALIA

CARNIVORA - CANIDAE

Canis aureus Kelaart [K]

CARNIVORA- FELIDAE

Felis chaus Kelaart [K]

CARNIVORA - VIVERRIDAE

Herpestes fuscus Waterhouse [B,H]
Paradoxurus hermaphroditus (Pallas) [B]
Viverricula indica Pocock [B]

CHIROPTERA - PTEROPODIDAE

Cynopterus sphinx (Vahl.) [B]
Pteropus giganteus (Brunnich) [B,H,K,N]

CHIROPTERA - RHINOCOPHIDAE

Rhinolophus sp. [B]

CHIROPTERA - VESPERTILIONIDAE

Myotis hasselti (Temminck) [B]

INSECTIVORA- SORICIDAE

Suncus murinus (L.) [K]

PERISSODACTYLA - EQUIDAE

Equus asinus L. [K]

PERISSODACTYLA- SUIDAE

Sus scrofa (Wagner) [B]

RODENTIA- MURIDAE

Bandicota bengalensis Gray & Hard. [B]

Rattus rattus L. [B,H]

SIRENIA- DUGONIDAE

Dugong dugon (Muller) [K]

Legends to figures:

Fig. 1 Sri Lanka showing the inland water resources in the west coast. Sampling areas are shown by arrows. Wet and dry zones are also indicated.

Fig. 2 Generalized food web of the west coast mangroves in Sri Lanka. Numbers indicate the following groups of animals.
1. polychaetes; 2. bivalves; 3. gastropods; 4. shrimps and prawns; 5. anomurans; 6. fish; 7. reptiles; 8. birds;
9. mammals.

Fig. 3 Zonation of the macroflora and macrofauna in the west coast mangroves. (a) dry zone mangroves in the Kalpitiya area. (b) wet zone mangroves in the Negombo and Balapitiya areas. Zonation of macrofauna is indicated only for the mangroves in the Kalpitiya area (dry zone), since there is little difference in the diversity and zonation of macroflora in the wet and dry zones (exceptions are given in the text).





